BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D.C. 20024

SUBJECT: Trip Report -- G-1 Mission Lunar Surface EVA Simulation - Case 320

DATE: February 10, 1969

FROM: T. A. Bottomley

ABSTRACT

On January 21, 1969, a simulated lunar surface EVA was held at MSC in order to evaluate time lines and procedures planned for the G-1 Mission.

All major activities were demonstrated excepting LM egress and ingress, and documented sample collection.

Observations noted in this memorandum relate to the fidelity of the simulation, difficulties experienced by the test subjects, and pertinent characteristics of locomotion in pressurized suits.

The writer's greatest concern is that lack of fidelity in simulation exercises will make it very difficult to obtain good baseline data for planning lunar landing excursions. Accordingly, specific recommendations are made to improve fidelity in the areas of lighting, equipment configurations and equipment weights; and, to provide liquid cooling for the test subjects.

BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

SUBJECT: Trip Report -- G-1 Mission Lunar Surface EVA Simulation - Case 320

DATE: February 10, 1969

FROM: T. A. Bottomley

MEMORANDUM FOR FILE

A simulation of the lunar surface activities planned during the G-1 mission was held at MSC on January 21, 1969.

The purpose of the exercise was to evaluate the time line and procedures for lunar sample collection and G-1 mission experiments (EASEP) deployment.

Attendees were from MSC, Bendix, NASA Headquarters, and Bellcomm (H. W. Radin* and the writer).

Astronauts H. H. Schmitt and D. L. Lind were the test subjects. They wore Apollo pressure suits and portable life support systems which are specially configured for operation in earth's ambient environment.

The following activities were accomplished during the simulation:

a) Contingency sample collection.

b) TV camera deployment and still photography.

c) EASEP deployment (solar wind, passive seismic experiment and laser ranging reflector).

d) Erectable antenna deployment.

e) Preliminary sample collection.

Activities which were not attempted were:

a) LM egress and ingress

b) Removal of the MESA and EASEP packages from LM descent stage stowage, and

c) Documented sample collection.

---

* Refer to: Suited Simulation of Lunar Surface EVA - Case 340. Trip Report by H.W. Radin dated January 31, 1969.

The following comments cover observations which were of special interest to the writer.

1. Simulation fidelity

a) The lunar surface was simulated by dark gray sand which had been spaded to make a very uneven, loosely compacted surface. Rocks, about fist-size, were distributed 7 to 10 feet apart. While the color and roughness of the surface may have been appropriate, the sand appeared moist and readily compacted into a hard surface in the course of the exercise. High level flood lighting completely eliminated all contrast and shadow effects.

b) Some of the lunar surface hardware used during the simulation was obsolete in configuration (e.g. TV camera). In addition, most of the equipment did not satisfy either lunar weight or correct mass requirements. As a result, measures of energy expenditures, mobility, and moment effects could not be even subjectively assessed.

c) Two experiments (passive seismic and laser ranging) were transported and deployed in only six minutes. However, this accomplishment was atypical. The remaining activities were broken-up by extended periods of standing time. Reasons for these interruptions included rest periods, discussions between the working astronaut and support personnel, and malfunctioning of the portable life support system.

2. Simulation Difficulties

a) The backpacks used during the simulation use liquid air for suit pressurization and gaseous cooling. (Liquid cooling is not provided.) Use of the liquid air results in frequent malfunctions due to valve freezing. Lack of liquid cooling and malfunction interruptions complicate the problem of obtaining good baseline data on metabolic energy expenditures and timelines.

b) Small details were dropped a number of times by the test subject when experiments were being deployed. In most cases the details were retaining clips or rings which were not subsequently required. In all cases, however, the crew member seemed unaware of having dropped the various small parts. Provisions should be made to ensure against loss of needed small parts during lunar EVA operations.

c) The cords to the TV camera and erectable antenna were extended through the area of maximum activity. The crewmen had to exercise extra caution in stepping over them as they did not lay flat. In addition, it was not established that the cords will be visible if the EV visors are down. The question of cord deployment and color should be investigated further.

3. General Observations

a) Observations were made of locomotion rate and standing time. Assuming that the astronauts made subjective adjustments to maximize stability and minimize effort, the findings were as follows:

1) Stride lengths averaged about two feet and did not exceed 30 inches.

2) Step rates averaged about 60 steps/min. and did not exceed 80 steps/min.

3) Standing time consumed about 1/3 of the total simulation time for the reasons previously mentioned in 1 (c) above.

b) During the entire simulation exercise only one crewman was "on stage" at any one time. There was no attempt made to have one crewman assist or share the load in accomplishing a discrete task objective. Assistance and task sharing should be considered in future evaluations.

RECOMMENDATIONS

In summary, it is recommended that:

1. The fidelity of future simulations be improved, especially in the areas of lighting, equipment configuration and equipment weight,

2. Alternate backpack designs be developed to reduce time lost due to malfunctions and to provide liquid cooling during simulations,

3. Provision be made to ensure against the loss of small parts on the lunar surface and to reduce interference from deployed cords, and

4. Lunar tasks be examined to determine where time and energy can be saved by cooperative effort on the part of the two EVA crewmen.

T. A. Bottomley

2033-TAB-scs

T. A. Bottomley

BELLCOMM, INC.

Subject: Trip Report -- G-1 Mission Lunar Surface EVA Simulation - Case 320

From: T. A. Bottomley

DISTRIBUTION

NASA Headquarters

Messrs. D. A. Beattie - MAL
H. S. Brownstein - MM
L. E. Day - MAT
C. C. Gay - MAT
G. H. Hage - MA
J. K. Holcomb - MAO
J. W. Humphreys - MM
T. A. Keegan - MA-2
A. F. Phillips - MAT
W. E. Stoney - MA
F. E. Stout - MAO
C. A. Wilkinson - MAB/Boeing

Bellcomm, Inc.

Messrs. A. P. Boysen
D. A. Chisholm
D. Cortland
D. R. Hagner
N. Hinners
B. T. Howard
D. B. James
A. N. Kontaratos
J. Z. Menard
T. Orrok
H. W. Radin
I. M. Ross
F. Schmidt
P. F. Sennewald
G. B. Troussoff
R. L. Wagner
Central Files
Dept. 2033 All Members
Department 1024 Files